REMARKS

Accompanying this response, please find marked-up paragraphs of the specification which overcome some informalities noted in the specification on file. The undersigned avers that the enclosed replacement paragraph(s) of the specification do not contain any new.

The subject matter of the Chapter II amended claims is revised to conform with the United States claim format and entered as new claims 25-48. Please consider these new claims when considering this application.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

[001] # ELECTRIC MACHINE

[002] ## FIELD OF THE INVENTION

[003] The invention concerns an electrical machine, in particular, serving as an electric motor for a drive for vehicles ~~in accord with the generic concept of Claim 1~~.

[004] ## BACKGROUND OF THE INVENTION

[005] Machines of this type are mostly asynchronous machines, which are constructed with a stator within which a rotor is provided. The rotor is designed to be of the squirrel cage type and is made preferably of electrically conductive aluminum, which is precision cast in a mold to the shape of the rotor. The aluminum, during the production, is poured into grooves formed by the laminate pack of the rotor. On the end of the rotor, the aluminum coils from the respective grooves are brought together into a ring thereby forming the said squirrel cage winding. The asynchronous motors are predominately run under heavy duty conditions and the heat generation by said motors calls for optimized cooling.

[006] Such a machine has been disclosed, for instance, by EP 0 484 548 B1. The electrical machines of this disclosed type possess an inward disposed rotor with a rotor shaft and a rotor laminate pack and an externally located stator. This electrical machine is connected with the cooling system of the vehicle.

[007] A particular problem with the cooling of such an electric machine is found in the bearing method to support the rotor shaft and in their sealing means. The heat transmitted from the rotor shaft to the bearings leads to bearing damage and, over time, to the failure of the machine. Because of high temperatures in the rotor shaft, large temperature differences consequently arise in the bearings between the inner bearing ring and the outer bearing ring. At the same time, circulation of a cooling medium in the electrical machine is made especially difficult by construction limitations presented by the machine.

[008] This leads to the fact that the generated temperatures, especially in the case of machines under heavy duty service, can not easily be conducted away from the internals.

[009] The present invention thus has the purpose of proposing an electrical machine, which makes a better transport of the cooling medium possible and protects the bearing of the machine from damage.

[010] This purpose is achieved in accord with the invention by the features of Claim 1. Embodiments of the concept of the invention are described and explained as objects of the subordinate claims.

[011] SUMMARY OF THE INVENTION

[012] For the purpose of cooling the machine, the heat generated by its operation must be transferred to a cooling medium. The medium must be easily transportable to the individual machine. Air is an advantageous cooling medium which itself, after such use, can be again cooled or exchanged for free air. Air is an excellent insulator, on its account, so that in an electrical machine, no special insulation means need be called upon in order to protect the various components of the machine against short circuit problems, which could arise from the characteristics of notice cooling medium. In order to conduct the cooling medium into the machine safely, possible flow restrictions must be avoided in every possible way.

[013] In accord with the invention, a cooling medium can be conducted through an area between a rotor laminate pack and a rotor shaft in an electrical machine which possesses an externally disposed stator, an inner, rotatably, bearing supported, hollow rotor, a laminated rotor pack, and a rotor shaft, connected to rotate with the laminate pack. For this purpose, the rotor shaft can be directly placed, in a rotational fixed manner, within the rotor laminate pack or, in an advantageous embodiment, a hollow interposed shaft may be inserted between the rotor laminate pack and the rotor shaft upon which shaft the rotor laminate pack is placed. Another embodiment shows the rotor shaft as a webbed shaft which possesses a plurality of webs on its circumference.

[014] In yet another advantageous embodiment, means are provided between the rotor shaft and the interposed shaft, i.e. the rotor laminate pack, to transport the

[020] In a further favorable embodiment, a heat exchanger is integrated into the electrical machine. The heat exchanger can have cooling tubes, which surround the stator and said cooling tubes can communicate, in a heat transfer manner, with provided cooling ribs. Cooling tubes can be provided directly within cooling ribs, which, with the cooling tubes which surround the stator, are inter-connectable. These cooling tubes embedded in the cooling ribs can, in one version, be installed at an angle to the cooling tubes which surround the stator. One embodiment shows the cooling ribs placed in a separate construction component, which can be mounted in the form of a cooling basin to the electrical machine.

[021] A preferred version employs air as the cooling medium.

[022] BRIEF DESCRIPTION OF THE DRAWINGS

[023] The invention will be explained and described in greater detail with the help of the drawings in which:

[024] Fig. 1 is an electrical machine with a star shaped, webbed shaft,

[025] Fig. 2 is a cross-section through a webbed shaft an rotor shaft as in Fig. 1,

[026] Fig. 3 is a cross-section through the heat exchanger, as in Fig. 1,

[027] Fig. 4 is an electrical machine with a shaft having sickle shaped internal webs,

[028] Fig. 5 is a cross-section through a webbed shaft and rotor laminate pack of Fig. 4,

[029] Fig. 6 is an electrical machine with a ventilating apparatus in the rotor shaft,

[030] Fig. 7 is a cross-section through the webbed shaft and the rotor shaft of Fig. 6,

[031] Fig. 8 is an electrical machine with a webbing arranged as an internal screw coil,

[032] Fig. 9 is a cross-section through a heat exchanger which possesses a cooling basin,

[033] Fig. 10 is a further cross-section through a heat exchanger with a cooling basin,

[034] Fig. 11 is a cross-section through the cooling basin in accord with Fig. 9, and

[035] Fig. 12 is a cross-section through the cooling basin in accord with Fig. 10.

[036] DETAILED DESCRIPTION OF THE INVENTION

[037] Fig. 1 shows an electric machine 2 with a rotor shaft 4, which rotates on two sets of bearings, namely 6 and 8, which are enclosed in a housing 10. The rotor shaft 4 possesses a toothed end 11, proximal to the bearing, by means of which the electrical machine 2 coacts with additional (not shown) elements of a line of drive mechanism. A rotor, a stator laminated pack 12, through which a stator winding 14 penetrates is placed in the housing 10. A rotor laminate pack 18, separated by a spacer opening 16, is situated radially within said stator laminate pack 12. The rotor laminate pack 18 is penetrated by metal pins 20, which preferably are made of aluminum. A cap 24 is fastened onto the rotor laminate pack 18 with screws 22. As an alternative, the metal pins 20 can be embedded in the rotor laminate pack 18 in a precision molding operation. The rotor laminate pack 18 is seated on a hollow interposed shaft 26, circular in cross section. The rotor shaft 4 is placed with said interposed shaft 26 by press a fit, so that it rotates as one with the interposed shaft 26. The rotor shaft can, however, be press fit directly into the rotor laminate pack. The rotor shaft 4 possesses four webs 28, which are arranged in the shape of a star (see Fig. 2). The webs 28, in the embodiment depicted here, provide open spaces 29, so that the webs 28 do not lie along their entire length against the inner wall of the hollow interposed shaft 26. In the empty spaces 30, a first cooling medium, preferably air, can be circulated through the interposed shaft 26 between the webs 28, that is, for cooling the connected rotor laminate pack 18 thereto. For this purpose, a ventilating fan 32, which brings about a flow of the cooling medium, is placed on an axial end of the rotor laminate pack 18. A steel ring sheet 34, which directs the cooling medium flowing through a heat exchanger 36 in the direction of the interposed shaft 26, without turbulence, is provided on the other axial end of the rotor laminate pack 18. The heat exchanger 36 possesses cooling ribs 38 (see Fig. 3) through which the